Space Weather Technical Forecast

Issued on Wednesday, 07 September 2022 at 12:41 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of G1 Minor Geomagnetic Storm day 1 (7th). Slight chance of M-class flare (R1 Blackouts) day 1 (7th). Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low with several C-class flares observed, mostly from ex-A3089. There are eight potential sunspot regions on the visible disc, four of which are numbered. AR3092 is the largest spot currently on the disk, now re-classified as a Alpha/Hsx. AR3094, in the northeast quadrant is showing slight decay. AR3096 near the northeast limb continues to show development of its trailing spot portion. There are several pores around the disc, some have been analysed as semi-persistent features, four of which are yet unnumbered but feature in this forecast. These features are all small and magnetically simple, however the group east of AR3092 has shown more significant recent spot emergence and has now been numbered AR3097.

There have been no Earth directed CMEs seen in satellite imagery over the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE and DSCOVR at L1, was indicative of a waning coronal hole HSS, with speeds fluctuating in the range 530km/s to 600km/s, and on a broadly steady trend. Density was average or below average. Total interplanetary magnetic field strength, Bt, was weak. The north-south component, Bz, varied equally between +6/-6 nT. The Phi angle was largely positive (away from the Sun). Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured at GEOS-16 was at background levels. The high energy electron flux (greater than 2 MeV) was at High levels, with a peak of 7270 pfu at 06/1850 UTC. The 24-hour integrated electron fluence resumed a slight upward trend, remaining above the Active threshold (1e8 integrated pfu). 2.57e8 integrated pfu was observed at 07/0000 UTC, with the most recent reading at 07/0900UTC 2.88e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be largely Low, with a slight chance of becoming Moderate with isolated M-class flares, mostly from ex-AR3089. This spot will likely exert influence on the flare risk due to its location until the end of day 1 (7th).

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected. Solar winds will initially be elevated due to the waning effects of the HSS from CH20/+, perhaps gradually easing to slightly elevated by the end of day 1 (7th). There is an outside chance of a HSS arriving from a faint un-numbered coronal hole, currently in the northwest quadrant through day 1 and perhaps into day 2 (7th or 8th). This may have the effect of keeping solar wind speeds elevated, though confidence on this is much lower than average. Wind speeds should then revert back to slightly elevated or background by late day 2 (8th) and for the remainder of the

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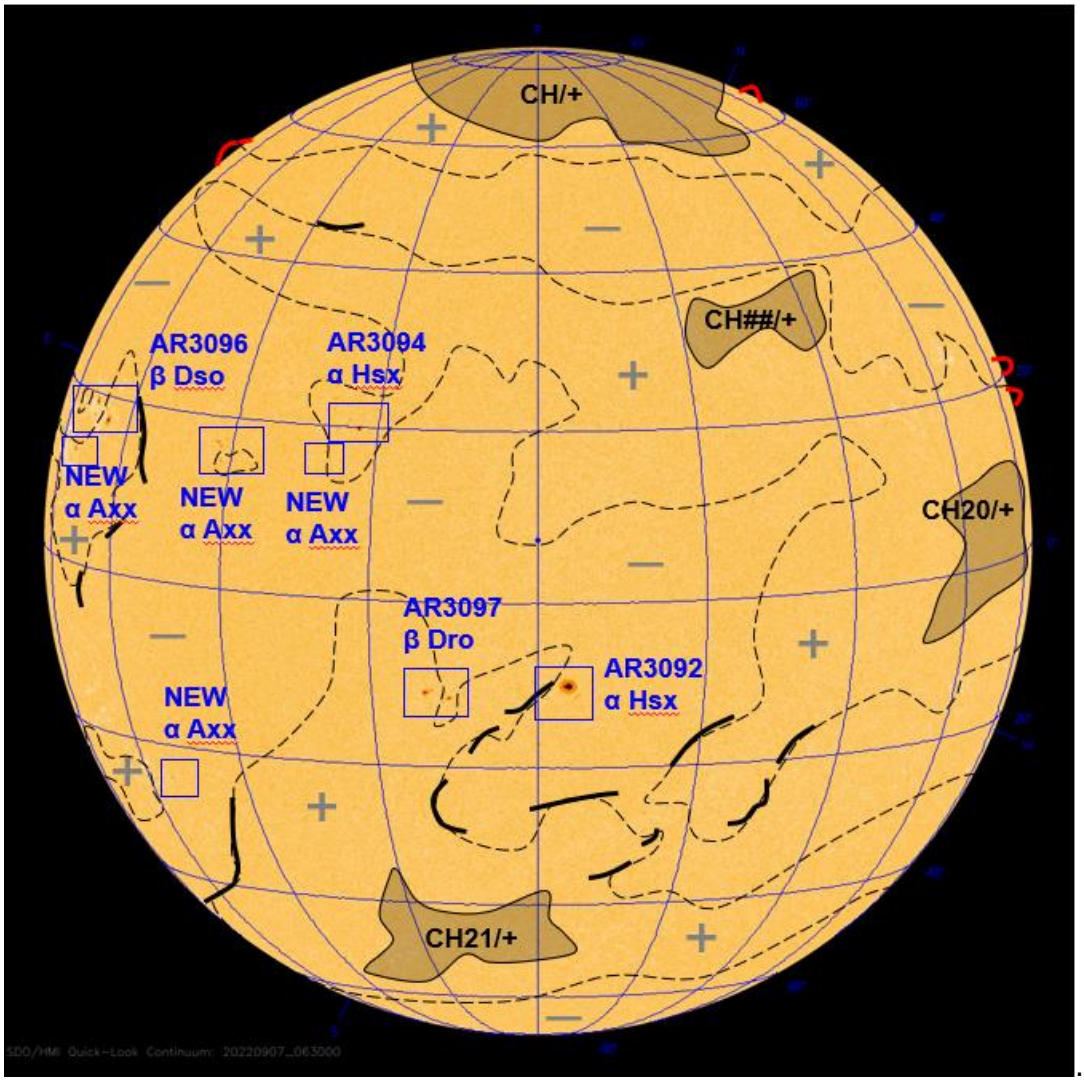
forecast period. Geomagnetic activity will likely be Unsettled to Active, with a chance of G1/Minor Storm intervals on day 1 (7th) and perhaps early on day 2 (8th). Baseline Geomagnetic activity should become Quiet to Unsettled (Kp 1-3) from late day 2 (8th) onward.
Energetic Particles / Solar Radiation: High energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels. The high energy (greater than 2 MeV) electron flux is expected to remain at high or moderate levels during days 1 and 2 (7th and 8th), with long periods over the 1000pfu threshold likely. Electrons will likely begin to subside from day 3 onward (9th-10th). The corresponding 24 hour fluence is expected remain above the Active threshold through during day 1 (7th), likely on day 2 (8th), before reducing to a chance on days 3 and 4 (9th and 10th)

Figure 1. Solar Analysis Valid 07/0630 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently expected.

Solar winds continue to be elevated from the waning effects of CH20/+. Wind speeds are expected to gradually ease over coming days, perhaps becoming background by the end of the period (10th). There is a risk of a HSS arriving from a faint coronal hole (evident on SDO 221 imagery but not 193), it's leading edge is around 40 degrees west of the central meridian, therefore perhaps enhancing winds speeds to elevated, with a small chance of strong. Confidence on this element of the forecast is much lower than average.

Geomagnetic activity will likely be Unsettled to Active, with a chance of G1/Minor Storm intervals on day 1 (7th) and perhaps early on day 2 (8th). Baseline Geomagnetic activity should become Quiet to Unsettled (Kp 1-3) from late day 2 (8th) onward.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

None currently expected.

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Radio Blackouts - X-Ray Flares:

There are currently seven sunspots on the visible disk. Solar activity is expected to be largely Low, with a chance of becoming Moderate with isolated M-class flares, mostly from ex-AR3089. This spot will likely exert influence on the flare risk due to its location until the end of day 1 (7th), when it will have rotate completely off the visible disk and past 110 degrees west.

A large filament continues to be visible in the southern hemisphere, now near centre disc and will need to be monitored for any lift-off. This filament has shown little change over the past few days and appears to be a rather stable feature at present.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	15	10	10	10
Very Active	R3 to R5 X Class	No	2	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) remains at background values. The location and complexity of all current sunspots on the visible disk suggest high energy protons (greater than 10 MeV) are expected to remain below S1/Minor radiation storm levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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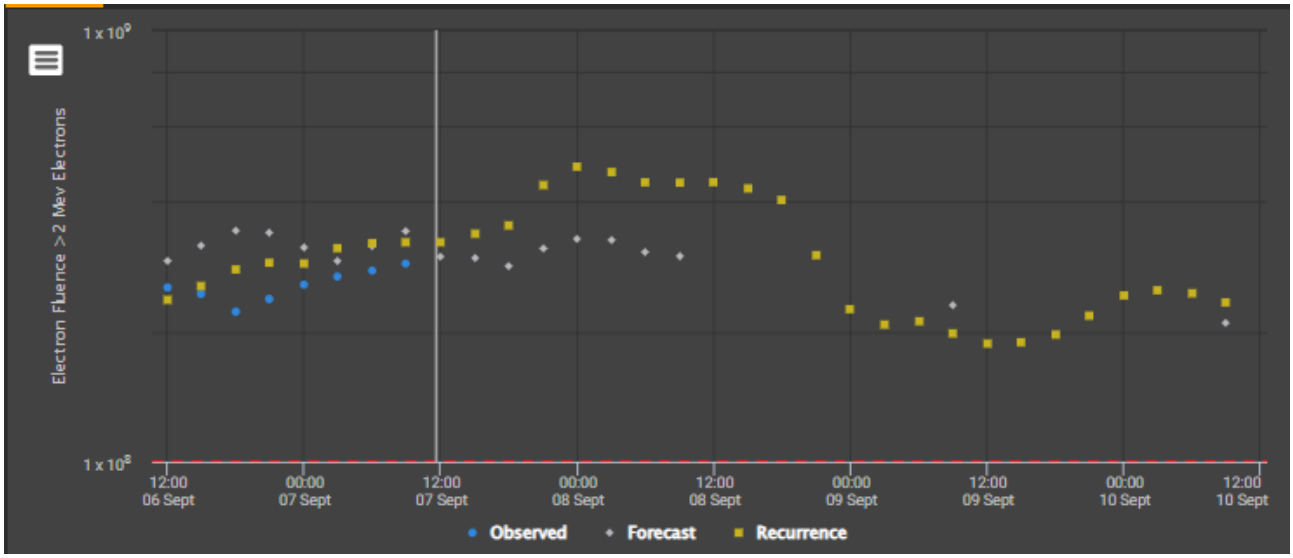
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is expected to remain at high or moderate levels during days 1 and 2 (7th and 8th), with long periods over the 1000pfu threshold likely. Electrons will likely begin to subside from day 3 onward (9th-10th). The corresponding 24 hour fluence is expected to remain above the Active threshold through during day 1 (7th), likely on day 2 (8th), before reducing to a chance on days 3 and 4 (9th and 10th).

REFM is thought to give good guidance for the likely elevated levels during day 1 and 2 (7th and 8th), though confidence wanes day 3 and beyond (9th-10th) due to the waning effects of coronal hole 20/+.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	70	40	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	5	2	1	1

Figure 2: MOSWOC REFM output



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